Logistics improvement in parcel delivery through address intelligence

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Introduction

The e-commerce sector in the Netherlands is continuously growing. Online spending on products amounted to €13.1 billion in 2018. This is an increase of 24% compared to the previous year (Thuiswinkel.org, 2019). This increase explains the growth of the number of parcels sent, which rose by 20% in 2018. The B2C segment, consisting of 70% of parcel volume, is the largest. While B2B and C2X markets account for 27% and 3% respectively (Autoriteit Consument & Markt, 2019). It is in the B2C segment where a lot of delivery challenges occur.

Where in B2B parcel delivery the receivers operate more as business partners; meaning that the processes are planned, repeatable and reliable, the B2C segment is less predictable, both due to fluctuations in demand, for example, the busy December period, and the unpredictability of the customers at-home status.

Especially the unpredictability of customers at-home status leads to a high rate of failed deliveries. This implies re-delivery, which generates extra costs, extra kilometres and extra emissions (van Duin, de Goffau, Wiegmans, Tavasszy, & Saes, 2016). This paper focuses on the possible benefits of intelligent addresses, mainly knowing the at-home status at an address, and how and to what extent intelligent addresses could help to solve this problem.

Approach

In the current situation, when a parcel cannot be delivered at the address of an addressee a delivery person will try to deliver a parcel at a neighbouring address. If none of the neighbours is at home as well, a parcel is taken back to the depot and the process is repeated the next delivery day. In the worst case, a failed delivery happens several subsequent delivery days which results in a parcel being delivered at a pick-up-point or worse, returned to sender.

The approach to finding out what knowing the at-home status can mean for logistics improvement in parcel delivery is to conduct multiple Monte Carlo simulations. For these simulations there needs to be an estimation of the at-home probability of an addressee, the number of neighbours tried before it is labelled as a failed delivery and the probability of a failed delivery. With this information the at-home probability of a neighbour can be calculated by the following equation:

$$\begin{matrix} probability \\ neighbours \end{matrix} = 1 - \left(\frac{\begin{matrix} first\ time\ not \\ delivered \end{matrix}}{1 - probability\ addressee} \right)^{\frac{1}{\begin{matrix} number\ of\ neighbours \\ tried \end{matrix}}}$$

Based on these at-home probabilities, Monte Carlo simulations can be conducted. During these simulations, it should be recorded how often the bell was rung on average per parcel, how many parcels were delivered to addressees, how many were delivered to neighbours and how many could not be delivered. With this data, the time and cost savings can be calculated. To calculate this data about the time needed per doorbell rang, the hourly labour cost and the hourly cost of a van are necessary as well.

The data

In a 2016 study conducted by van Duin et al, the following figures about the first-time-right deliveries where given:

	Delivery Options	*Percentage*
First Time Right (address)	Receiver is at home for 1st delivery	75%
First Time NOT at Right (address)	Delivery is given to neighbours	15%
First Time Not delivered	Back to depot and prepared for 2nd delivery	10%

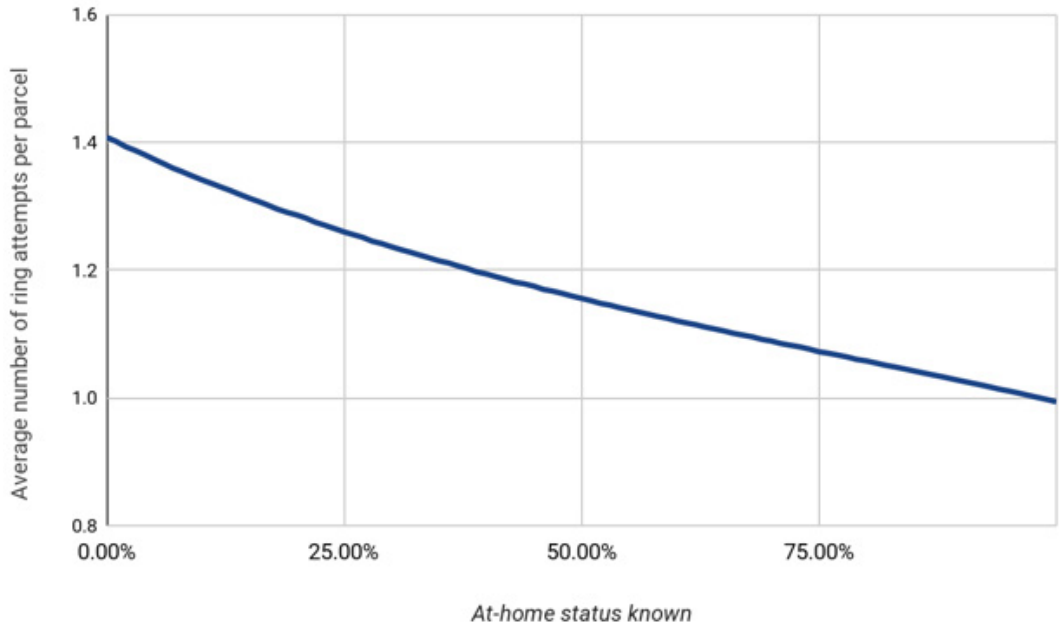
First Time Right deliveries for a webshop with minimal delivery options (van Duin, de Goffau, Wiegmans, Tavasszy, & Saes, 2016)

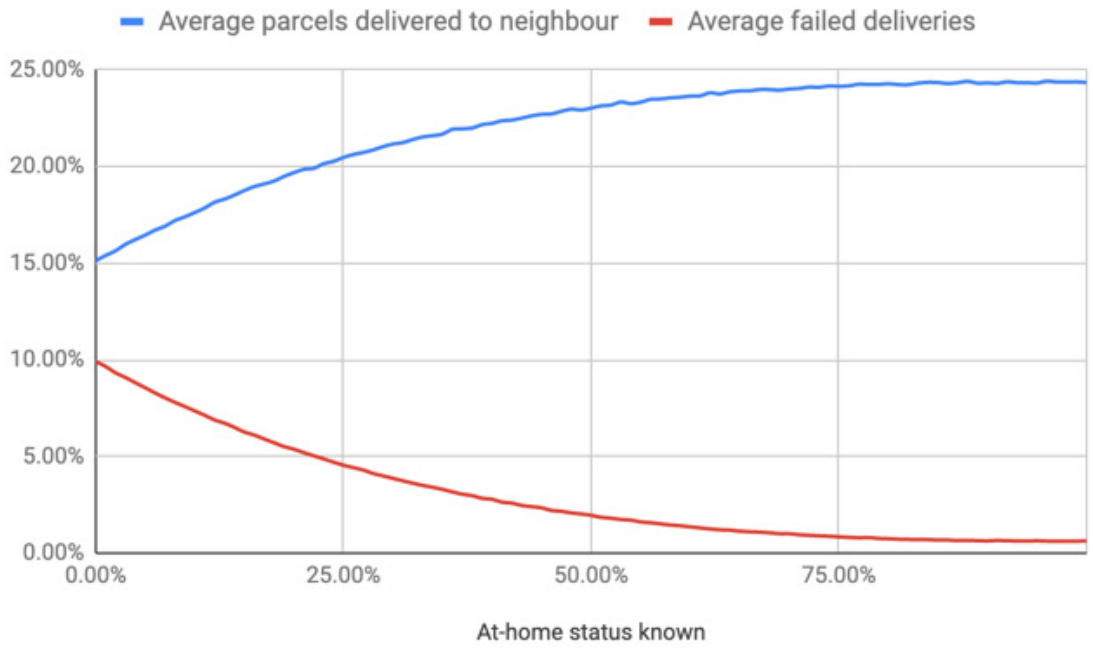
Note these figures might be outdated, yet since updated records contain contradictions, the data determined by van Duin et al will be used for further calculations.

The at-home probability of the addressee is equal to the first-time-right percentage. The at-home probability of a neighbour differs from the at-home probability of the addressee. This could be because a neighbour, unlike the addressee, is not aware of an inbound parcel. Using the equation given in the previous chapter, assuming that if an addressee is not at home, two neighbours are tried, the at-home probability of a neighbour is equal to 37%.

Monte Carlo simulation

Based on these probabilities, several Monte Carlo simulations where run. With each simulation, the number of addresses for which the at-home status is known in advance, is increased. This resulted in the following graphs:





These simulations show that the number of ring attempts can be reduced by 12% and failed deliveries can be reduced by 61% if the at-home status of 30% of households can be determined in advance. This implies huge logistics improvements for parcel delivery services.

Determining the time per ring

In the current situation two minutes per stop is assumed (van Essen, 2015). These two minutes only say nothing about what ultimately happened with the delivery (delivered at the addressee or the neighbours etc.). What can be deduced from this is that these two minutes equals the value of the number of rings with a known at-home status of 0%. The time saving per delivery that address intelligence makes possible can, therefore, be calculated using the following equation:

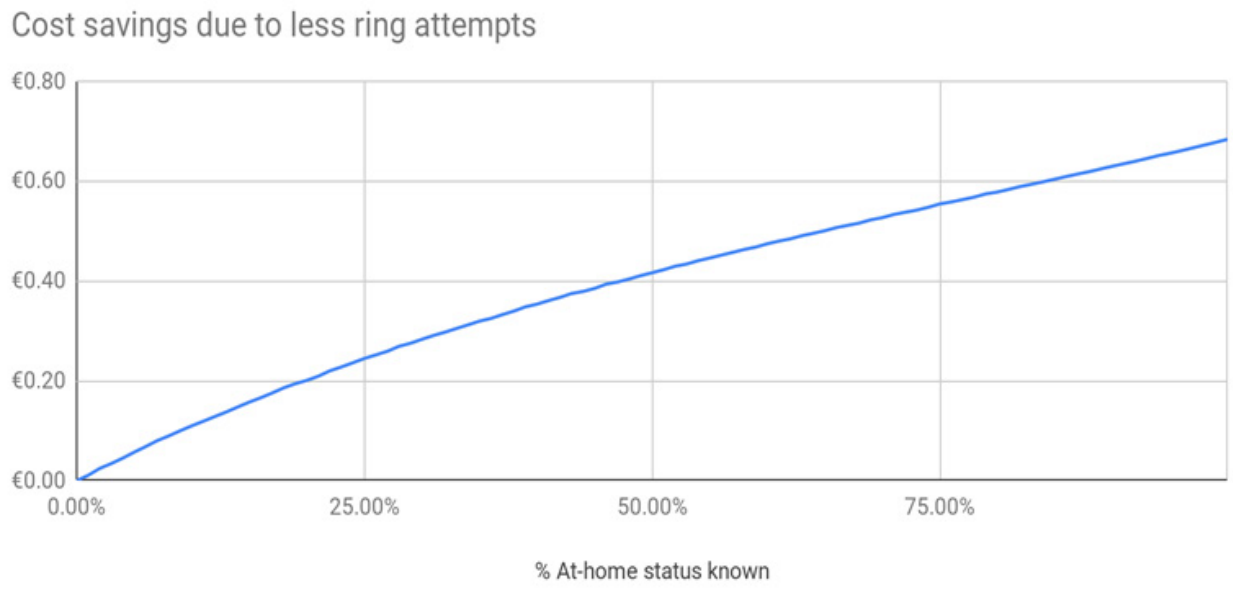
$$time_{n\%} = time_{0\%} - \frac{time_{0\%} \times ring_{n\%}}{ring_{0\%}}$$

Cost benefits of less ring attempts

Based on the data gathered in these simulations an estimation can be made about the potential cost savings for parcel delivery services in the Netherlands by looking at the hourly cost of parcel delivery. The following numbers are assumed:

- Gross hourly labour costs are estimated to amount to € 25.
- The cost of a new company car lease (Opel Movano) with a 3-year contract is € 1706,70 per month on leaseplandirect.nl. Which amounts to €9,85 an hour.

This indicates the following cost savings based purely on the time savings of less ring attempts:



It is important to note that this is about the average saving per package delivered and not purely about the first-time-right deliveries.

Other benefits

In addition to the direct cost savings due to the fewer ring attempts, being able to request the at-home status also offers other benefits.

Less failed deliveries
As can be seen in the results of the simulation, the number of failed deliveries is also decreasing with the use of address intelligence. This means that parcels do not have to be returned to the depot as often, after which they have to be delivered again the next day. It is estimated that one failed delivery costs around €7,50. Which also implies financial benefits of a couple of dozens cents per parcel.

Control of processes
At this time, it is difficult to estimate how long it will take to deliver a parcel. This is caused by the disruptions that can occur in this process. Address intelligence can make the delivery process more predictable. Since with more insight into the at-home status of consumers, the time per delivery becomes more consistent. This allows the ETA of a delivery to be determined more accurately, which simplifies planning. This would also open the door for other ways of delivery.

In cooperation with

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